Guidance for Submitting Exceptional Event Demonstrations
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Are You Ready for an Exceptional Event?
The Exceptional Events Rule clarifies that it applies to the treatment of data showing exceedances or violations for the following types of regulatory actions:

- An action to designate or redesignate an area as attainment, unclassifiable/attainment, nonattainment or unclassifiable for a particular NAAQS. Such designations rely on a violation at a monitoring site in or near the area being designated;
- **The assignment or re-assignment of a classification category (marginal, moderate, serious, etc.) to a nonattainment area to the extent this is based on a comparison of its “design value” to the established framework for such classifications;**
- A determination regarding whether a nonattainment area has attained a NAAQS by its CAA deadline. This type of determination includes “clean data determinations;
- A determination that an area has data for the specific NAAQS, which qualify the area for an attainment date extension under the CAA provisions for the applicable pollutant;
- A finding of SIP inadequacy leading to a SIP call to the extent the finding hinges on a determination that the area is violating a NAAQS; and
- Other actions on a case-by-case basis if determined by the EPA to have regulatory significance based on discussions between the air agency and the EPA Regional office during the Initial Notification of Potential Exceptional Event process.
### Comparison of 2016 Design Values with and without May 25 and 26, 2016 Data, and Corresponding 2017 Critical 4th High Values at the Four Sites Proposed for Exclusion.

Critical 4th high is the value at which the monitor will exceed the NAAQS (in parenthesis) for the 2017 season.

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<tbody>
<tr>
<td>Abington</td>
<td>67</td>
<td>70</td>
<td>74</td>
<td>70</td>
<td>69 (70 ppb NAAQS)</td>
<td>67</td>
<td>68</td>
<td>76 (70)</td>
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<tr>
<td>Westport</td>
<td>81</td>
<td>87</td>
<td>87</td>
<td>85</td>
<td>81 (84 ppb NAAQS)</td>
<td>81</td>
<td>83</td>
<td>87 (84)</td>
</tr>
<tr>
<td>Cornwall</td>
<td>68</td>
<td>76</td>
<td>78</td>
<td>74</td>
<td>74 (75 ppb NAAQS)</td>
<td>74</td>
<td>72</td>
<td>78 (75)</td>
</tr>
<tr>
<td>East Hartford</td>
<td>77</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>78 (75 ppb NAAQS)</td>
<td>72</td>
<td>74</td>
<td>81 (75)</td>
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Guidance Documents and FAQs
Updated April 2019

- **High Winds:** [Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Air Quality Data Influenced by High Wind Dust Events Under the 2016 Exceptional Events Rule](April 2019)
- **Data Modification:** [Clarification Memo on additional Methods, Determinations and Analyses to Modify Air Quality Beyond Exceptional Events](April 2019)
- **Stratospheric Ozone:** [Guidance on the Preparation of Exceptional Events Demonstrations for Stratospheric Ozone Intrusions](November 2018)
  - Forecasting Tools for Stratospheric Ozone Intrusions (PDF)
- **Wildfire:** [Final Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations](September 2016)
- **Updated Exceptional Events Rule FAQs** (July 2018)

Other EPA-Developed Rule Implementation Documents

- Best Practices for Preparation of Multi-Agency Exceptional Events Demonstrations
- 2007 to 2016 Exceptional Events Rule Crosswalk
- EPA Review Technical Support Document Template for Wildfire/Ozone Events
- Fact Sheet – Wildland Fire and Air Quality
What Elements are required for the Demonstration?

1) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);
2) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
3) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;
4) A demonstration that the event was both not reasonably controllable and not reasonably preventable;
5) A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event; and
6) Documentation that the submitting air agency followed the public comment process.
## A Tale of Tiers

The demonstration must establish a clear causal relationship between the specific event and the monitored concentration. Tier 3 is a ‘heavy lift’ because of the weight of evidence required, so strive for Tier 1!

<table>
<thead>
<tr>
<th>Tier 1: Section 3.4</th>
<th>Tier 2: Section 3.5</th>
<th>Tier 3: Section 3.6</th>
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<tbody>
<tr>
<td>Wildfires that clearly influence monitored O3 exceedances or violations when they occur in an area that typically experiences lower O3 concentrations. This tier is associated with an O3 concentration that is clearly higher than non-event related concentrations, or occur outside of the area’s normal O3 season.</td>
<td>The wildfire event’s O3 influences are higher than non-event related concentrations, and fire emissions compared to the fire’s distance from the affected monitor indicate a clear causal relationship.</td>
<td>The wildfire does not fall into the specific scenarios that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.</td>
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</table>
May 25, 2016 - Tier 3 was Required!

Numerous Canadian Wildfires around Fort McMurray, Alberta on May 18, 2016

168 hour Back Trajectories Ending Height = 800m
Westport CT Monitor
Are your Q’s and D’s in Order?

• EPA guidance recommends conducting a fire emissions / transport distance ratio (Q/d) analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations (For Tier 2 or 3 determination).

• The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern.

• If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern.

• EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone.
Step 1: Estimate the emissions from the fire (Q): (BlueSky Playground)

\[ F_i = P_i \times L \] (Equation 1)
\[ E_i = F_i \times A \] (Equation 2)

- \( F_i \) = emission factor (mass of pollutant/unit area of forest consumed)
- \( P_i \) = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
  - \( = 12 \text{ kg/Mg (24 lb/ton)} \) for total hydrocarbon (as CH₄)
  - \( = 2 \text{ kg/Mg (4 lb/ton)} \) for nitrogen oxides (NOₓ)
- \( L \) = fuel loading consumed (mass of forest fuel/unit land area burned)
- \( A \) = land area burned
- \( E_i \) = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

\[ E_i = P_i \times L \times A \]

\( Q \) is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends, in the exceptional events guidance, that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become \( rHC = 0.6 \times Ehc \) or \( 0.6 \times 17,991 = 10,794 \) tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions (2967 tons). Therefore the total rHC and NOx emissions over the period are \( 10794 + 2965 \), or \( 13,759 \) tons over the six days.

On average this resulted in a daily emission rate, or \( Q \), of 2293 tons per day.
Q/d Estimates for the Fort McMurray Fire

Step 2: Estimate the distance from the fire (d).

Based on the large distance, we did not present individual analyses for each monitor in Connecticut but estimated the distance from the Fort McMurray fire to the most distant point in Connecticut. We used a value of d of 3286 kilometers, the flight distance from Fort McMurray to Stonington, CT.

Step 3: Calculate Q/d.

Using the values determined above, Q/d = 2293 tpd divided by 3286 km = 0.69 tpd/km. This value is well below the EPA recommended level of 100 tpd/km indicating clear causality.

Step 4: Choose your Tier!
Available Tools for Weight of Evidence Analysis

- **NOAA Model Forecasts** and **Airnow AQI maps**;
- **NOAA OSPO** analyzed smoke plume coverage;
- **MODIS/VIIRS Satellite with AOD estimations** *(Worldview)*;
- **Calipso satellite** aerosol analysis;
- **Airnowtech Navigator** trajectory analysis;
- **Hysplit** trajectory analysis;
- **NOAA Aerosol Watch**;
- **Bluesky Smoke Model Runs**;
- **EPA Remote Sensing Information Gateway** *(RSIG)*;
- **Guide to Using Satellite Images in Support of Exceptional Event Demonstrations** *(HAQAST)*.
On May 1, 2016, a wildfire began southwest of Fort McMurray, Alberta, Canada. On May 3, it swept through the community, destroying approximately 2,400 homes and buildings and forcing the largest wildfire evacuation in Albertan history. The fire spread across approximately 590,000 hectares (1,500,000 acres) before it was declared to be under control on July 5, 2016.
Fort McMurray Wildfire Images (from Press Coverage)
Fort McMurray, Alberta, Wildfire Exceptional Event Request for May 25-26, 2016 Connecticut Ozone Monitor Data

On May 25, 2016, an unusual area of elevated ozone concentrations over the upper Midwest and New York State moved into New England. This was unusual this early in the season and with the meteorological conditions present. It became apparent that the elevated ozone was likely due to the persistent Fort McMurray wildfire smoke plume that had been moving toward New England for several days. Therefore, in accordance with 40CFR 50.14, CT DEEP has flagged its ozone monitoring data for the period lasting from May 25, 2016 through May 28, 2016 for treatment as influenced by an exceptional event.

CT DEEP announced a 'Notice of Intent to Submit an Exceptional Event Demonstration to EPA and Opportunity for Public Comment' on April 18, 2017, which lasted through May 1, 2017. No comments were received except for a letter from EPA Region 1 stating that they had no further comments at this time. On May 23, 2017 the final version of the Exceptional Event Demonstration was electronically sent to EPA Region 1 for their review. On July 31, 2017, CT DEEP received a letter of concurrence from EPA Region 1 approving our Exceptional Event Demonstration.

Image of the wildfire as it approaches Fort McMurray Alberta in early May, 2016

EPA Concurrence Letter and TSD Approving the Exceptional Event Demonstration
Cover Letter submitted with the May 23, 2017 Exceptional Request Demonstration
Final Submittal of the Exceptional Event Demonstration, May 23, 2017
EPA Letter- Acknowledging Review of Draft Demonstration, May 19, 2017
Notice of Intent to Submit an Exceptional Event Demonstration to EPA and Opportunity for Public Comment
Technical Support Document for Exceptional Event Analysis- DRAFT FOR PUBLIC COMMENT (.pdf)
EPA Response to CT Exceptional Event Request (.pdf)
Notification Letter to EPA Region 1, for May 2016 Potential Exceptional Event (.pdf)

Supplemental Materials
Presentation of Exceptional Event Analysis (ppto)
Animation of Ozone AQI Levels (.wmv)
Animation of Fort McMurray Wildfire Smoke Plume (.wmv)
Animation of Carbon Monoxide (CO) Plume (.gif)
Animation of Black Carbon (BC) Plume (.gif)
Animation of Aerosol Optical Depth (AOD) Plume (.gif)
The European Space Agency TROPOMI instrument produced NO$_2$ images showing the magnitude of NYC NO$_2$ sources (3x7 km). The previous OMI satellite NO$_2$ images did not have sufficient grid resolution for this, but were useful for trends.
Using Open Access Hub for TROPOMI Retrievals
Using Panoply to Display Satellite Data

- Comparing the TROPOMI CO column with the MODIS AOD is useful in determining whether the aerosols are the product of dust or wildfires.
Widespread temperature inversion caused PM2.5 levels to elevate over the entire Northeast and also trapped NO₂ in the lower boundary layer along the river basins and urban corridors. Could we be seeing NO₂ from the mobile sources along the highways?
Using RSIG for TROPOMI NO2 Retrievals

- High resolution satellite images will be critical for future SIP development/trends.

TROPOMI: 7 km x 3 km grid resolution
July 2, 2018 GCAS NO$_2$ NYC Flyover Animation (LISTOS)
July 2, 2018 GCAS NO2 with 1 Minute Ozone at 14:00
Narrow’s 16 CTs were a major source of NOx

<table>
<thead>
<tr>
<th>Narrows Generating Station</th>
<th>Unit NOx Pounds</th>
<th>NOx Rate</th>
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<tbody>
<tr>
<td>CT01-1</td>
<td>1184.1</td>
<td>0.335</td>
</tr>
<tr>
<td>CT01-2</td>
<td>681.7</td>
<td>0.335</td>
</tr>
<tr>
<td>CT01-3</td>
<td>493.5</td>
<td>0.335</td>
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<tr>
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<tr>
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<tr>
<td>CT02-8</td>
<td>1336.6</td>
<td>0.335</td>
</tr>
<tr>
<td><strong>Total pounds NOx</strong></td>
<td><strong>13196.2</strong></td>
<td></td>
</tr>
</tbody>
</table>
OMI Satellite Animation NO$_2$ Trend 2005-2016

Video Credit: NASA Goddard Space Flight Center
2004/2016 eGRID NOx Point Source Emissions

- Note the abundance of 10,000+ tons annual NOx sources upwind of CT in 2004 (reported to EPA).
A study conducted by the Lamont-Doherty Earth Observatory at Columbia University makes use of two NASA satellite products: measured tropospheric air column NO$_2$ (a surrogate for NO$_x$) and formaldehyde (as a surrogate for VOC). As depicted in Figure 2-13, Jin et al.'s findings indicate that on a regional scale, summertime ozone formation in the Northeast tends to be more NO$_x$ limited. Therefore, it is appropriate to favor NO$_x$ control strategies on a regional basis.

**Figure 2-13.** Ratio of formaldehyde in the air column, as surrogate for VOC, to tropospheric column NO$_2$ indicate that ozone formation in the warm season tends to be NO$_x$ limited in the northeast region of the United States. (Jin et al.)
Suggestions

• Can Worldview integrate the GOES16/17 images into layers, similar to what Aerosol Watch has done?
• RSIG application needs more TROPOMI data and wind vector analysis.
• Looking forward to future launch of the geostationary TEMPO instrument. Make sure Connecticut (and other States) are involved.